Teachers Room
D151241

EDUCATIONAL RESEARCH BULLETIN: ERB

MAR 31 1945

FEBRUARY 14, 1945

COLLEGE OF EDUCATION
THE OHIO STATE UNIVERSITY

Vol. XXIV, No. 2

D 151241

Educational Research Bulletin

FEBRUARY 14, 1945
Vol. XXIV, No. 2

Is There a Field of Educational Engineering?

MAR 31 1945

By W. W. CHARTERS

For twenty years, the writer has been playing with an affirmative answer to the question posed in the title of this article. On occasion, he has spoken informally of curriculum "engineering." Curriculum planners carry on activities and have ideals that parallel those of engineering, but caution has always prevailed against the public use of the term. Always present has been the fear that educators might be accused of borrowing the prestige of the engineer.

Recently, however, the question emerged in friendly conversation. Other educators had noted the parallel between engineering and education and felt with the writer that the new term might be used honestly. They were convinced that some educators devoted their time to building mental structures and educational programs in a thoroughly professional spirit and with substantial techniques. They admitted freely that the techniques lacked the superlative polish of the methods of the engineer, but they maintained that enough had been invented and used to justify the claim that educators are engineers of a special sort. Educational engineering is as far advanced as engineering was perhaps fifty years ago, long after engineering had been accepted and given a recognized position among the professions. Consequently, it seemed to be timely to explore the question.

That there is need for the engineering concept in education is obvious to anyone who has studied the trends in education for the last four decades. Since the turn of the century, the long-established patterns of education have been under fire, and new ideas have overwhelmed the educators. Prior to 1900, the methods of school men were simple. They sprang from the idea that the objective of education was to master subjects

like the three R's, and in such mastery in some fashion to develop character. The content of the subjects followed accepted patterns and was not subject to radical investigation. Teaching was essentially concerned with the mastery of information and the development of fundamental skills.

During the intervening period, however, for reasons which do not need to be mentioned, a constellation of new ideas has appeared. Growth is the most potent of the new concepts. Integration, indoctrination, guidance, evaluation, democratic education, organismic education, function, structure relations, socialization, and objectives are illustrations of other concepts which have claimed the attention of the educators during the last forty years.

These ideas have enormous implications and are integral parts of that revolution in education which will mark the twentieth century in any future history of education. They have, however, appeared upon the stage of education in such rapid succession that educators have been engrossed in the task of merely discovering what they mean. The educators are having a field day for theorists, who with prolific imagination and startling initiative analyze the new concepts. Despite the growth of educational research, this is yet the day of the idea men in education; men who love to work with ideas, explore their bases, examine their interrelations, and speculate about their implications for educational practice. Idea men are the custodians of progress. They are key men in many organizations. They are useful in conferences. They help the confused. They are handy men to have around.

THE idea man, however, is not usually deeply interested in giving body to his ideas. He assumes that if he sells his idea someone else will put it into practice. The typical idea man is not an engineer. The patience and persistence that are necessary to build a structure of methods and programs to carry his idea into practice are not his conspicuous characteristics. He is rather futile in a one-man organization. He has a proper place in a group where he is supplemented by colleagues who have as great a passion for building as he has for proposing the programs to be built.

The dominance of the idea man in education today has produced a situation in which typical writers of books and

articles, as well as speakers in classrooms and auditoriums, devote their hearty interests to the exposition of ideas and theories. They sincerely believe that if they give their audiences a new idea they have made a sufficient contribution to education.

The idea man has another serious weakness. He does not know whether or not his idea is good because he has neither planned the operations for putting it to work nor tested it in the field of practice where he predicts that it will work. Failure to operate and test an idea is the weakness of the educational theorist. Inevitably, an original idea must be modified or discarded when it is put to work.

Fortunately, however, many men and women in education are interested in the materialization of ideas. They often are classroom teachers who are fertile in planning and carrying out programs which give substance to theories. Such a teacher is fortunate if he is employed in an experimental school where the faculty, after enthusiastically accepting an idea, confers and experiments with patience and intelligence to construct procedures which will achieve substantial results. Sometimes these persons work in laboratories as psychologists, statisticians, curriculum constructors, or testers. Thus, a growing body of specialists of many kinds are subjecting their ideas to proof before they report them. These are the builders. They invent or accept ideas merely as the preliminary step to enjoying the deeper pleasure of producing programs and carrying them out. It is to these persons that the term, the educational engineer, might be applied.

IN EXPLORING the parallel between engineering and education, we have happily discovered a notable book, *The Engineering Profession*, by T. J. Hoover and J. C. L. Fish,[1] which treats engineering functionally and analytically. Their definition of engineering, each of the elements of which will be used as a basis for comparison, is the following: "Engineering is the professional and systematic application of science to the efficient utilization of natural resources to produce wealth."[1]

Engineering is a profession. This implies both an acquired background of theoretical training and a recognition of responsibility to the public. These two characteristics of the profession

[1] Stanford University, California: Stanford University Press, 1941. p. 10.

belong to education. Education is a profession because it recognizes its responsibilities both to children and to the social order. It may indeed be argued that it is more sensitive to these obligations than is engineering. Engineering works primarily with things; education deals essentially with people. Education, likewise, provides special, organized, and theoretical training for its members in the fields of school administration, methods of instruction, testing, guidance, philosophy of education, and so forth. Not that the disciplines are as rigorous as those of engineering. The difference, however, is one of degree rather than of kind.

The word, *systematic,* implies "the thoroughness and impartiality with which the truth is pursued."[2] The layman is amazed at every turn by the thoroughness of the well-trained engineer. Every day, we read in the magazines and hear over the radio about engineering exploits on the seven seas. This current global contest is a war of engines. Our peaceful culture, too, is permeated with the contributions of the engineers.

Education cannot yet lay claim to an equal degree of thoroughness, but substantial beginnings have been made. Controlled comparisons have taken the place of random samples. Objective testing has replaced subjective judgment in many areas and is growing both in validity and reliability with an accelerated tempo. Curriculums are being systematically based on analyzed functions rather than upon traditions. Vocational guidance has painstakingly developed effective techniques to supplement the judgment of advisers, and methods of instruction are subjected to rigorous evaluation. Those who know the field of education best regret the paucity of perfected techniques to ensure thoroughness, but they realize that substantial beginnings have been made. Again, the difference between engineering and education is one of degree rather than of kind.

The definition states that engineering deals with some of the *applications of science* to its problems. The sciences basic to engineering are physics, chemistry, and mathematics. Educational engineering, also, applies its own basic sciences. Its basic areas are psychology, sociology, and mathematics, but these are supplemented by many others—nutrition, physiology, philosophy of education, and the subjects in which instruction is provided by the schools.

[2] *Ibid.* p. 11.

It must be granted, however, that the sciences which are basic to engineering are much more exact than those which education must use and that engineers have developed techniques of application which are much more efficient and more numerous than those which educators have developed. Undoubtedly, a profession which deals with people cannot hope to be as efficient as one which deals with things, but even to human problems applications of science make substantial contributions through education. Here again the parallel holds. Both fields apply the resources of the sciences to their problems.

Efficient utilization is the pride of the engineer. He savors the definition of engineering as "the art of doing well with one dollar what any bungler can do with two after a fashion." The systematic and thorough use of science in engineering is directed in great measure toward raising the ratio of work output to energy intake. Whenever the engineer eliminates friction, invents shortcuts, increases manpower output, or decreases costs, he increases efficiency.

The educational engineer has many leagues to travel before his goal is reached, but he has made many beginnings. The measurement of achievement in terms of information, attitudes, and skills has greatly improved. The location of difficulties and their diagnosis and remedial treatment have made spectacular progress. The recent and notable *Encyclopedia of Educational Research* is an evidence of the aspirations of a profession toward efficiency.

Engineering, by the definition, utilizes natural resources. Of these there are two types—materials and power. The materials come from three kingdoms: animal, mineral, and vegetable. The great natural resources of power are coal, gas, oil, wind, and falling water.

Education deals primarily and essentially with ideas, feelings, skills, purposes, institutions, and traits of personality. These are the "materials" with which it works. For power it uses drives, urges, interests, needs, anxieties, and satisfactions. Its resources are best described as human resources, supplemented and conditioned by natural resources. Human factors are of concern to the engineer as well as to the educator but in a secondary position of importance.

Finally, engineering operates to produce wealth. This ultimate objective is widely conceived by the engineer. It does

not imply money alone. It includes all those things which serve a useful purpose. Education also moves toward wealth as its objective, but educators use other names for the idea. They speak of satisfaction or growth or values of similar import. Both professions have identical objectives; the resources used to achieve the ends are different.

It is evident that if these comparisons based upon the definition of engineering are valid, we are justified in adopting the term *educational engineering* as a dramatic reminder to educators that the omnipresent man of ideas in education must be vigorously supplemented by those who are dedicated to the service of giving body to ideas.

AN ENGINEER is a builder. He builds structures to fulfill functions. He is a solver of problems. When a problem is given to him, his task is to find a solution.

Obviously, every human being with a minimum of intelligence is a builder or a problem solver. Faced with a new situation wherever his activities are blocked and his purposes frustrated, he tries to build a program to solve the difficulty. When he does this, he assembles the facts and ideas that he already knows; he makes guesses as to what might work; he tries out techniques, tests them, and uses them. This is the essence of human intelligence—the formal steps of reflection. It is the pattern followed in the scientific method and is the heart of the engineering method. It is the common possession of all people, the native pattern of intelligent life.

In the field of education, the ability to think is one of the objectives of instruction, major in importance and of greater power than the assimilation of facts. Pupils everywhere are taught to master the process of reasoning. All teachers today encounter new problems arising from the actions of pupils, their misconceptions, and their lack of social adjustment. They construct methods and programs that will offer solutions. They build out of what they have at hand. School administrators, too, face new situations related to the public, to teachers, and to pupils as well as to the techniques of administration. When they become conscious of problems, they devise methods to meet the situation.

At first thought, it may appear that since everyone connected with education is a builder of methods, he is an engineer

of education. But by the same reasoning, every mason, every mechanic who builds machines and buildings, every carpenter, and every garage man is an engineer. There are, however, four characteristics which differentiate the engineer from the worker and the educational engineer from the practitioner. The differences are again differences of degree rather than of kind.

THE core of engineering is an attitude. The engineer has a passion for building things and making them run. He may be an idea man and think up his own inventions, or he may have the idea given to him, but in either case, his happiness lies in devising a method, a structure, or a program that he hopes will work. The educational engineer, too, loves to plan, to organize, and to operate. In the administrative field, he is known as the organizer; in the laboratories, he builds instruments, sets up procedures, and puts them into operation; in the curriculum field, he starts with the function of an area and happily analyzes it, collects materials, organizes them, and tries them out. The idea man, as we have said, is bored by these activities. They seem to him to be details which someone—anybody—else can undertake. The educational engineer is interested in philosophy and theories and the situations from which ideas emerge, but he studies them primarily to get his bearings in attacking a problem. To him the program is the thing. He gets pleasure not from merely savoring an idea but from building a structure and experiencing the satisfaction that comes from its efficient operation. While the idea man says, "This is a grand idea," the educational engineer says, "These are masterly methods for carrying out the idea." One loves to play with theories; the other loves methods. One enjoys argument; the other loves production.

A second characteristic of the engineer is that he is well grounded in information. He knows the principles and facts of his basic science from long-continued study and has learned the techniques of applying them. Although the engineer may acquire a substantial body of information—frequently he is the equal of the experts—through experience, he ordinarily has learned his basic sciences in systematic fashion in the classroom. Entering the profession with knowledge that has not yet been completely assimilated, he blends it with his experience through the years and grows in the ability to apply what he has learned.

The educational engineer learns the facts and principles of statistics, psychology, administration, or instruction, depending upon the field in which he wishes to specialize, and frequently masters new fields when he discovers that they are necessary for the solution of his problems.

A third characteristic of the engineer is a passion for efficiency. He searches continually for shorter methods of getting results. He eliminates frictions. He tests methods at all levels and gains satisfaction from observing operations that do not function properly as well as those which are successful. He laboriously analyzes problems and circumstances to discover the factors which operate, and isolates the essential difficulties which, when controlled, will solve the problems. Functional simplification is his persistent objective. A final characteristic to be mentioned is his patient thoroughness.

This characteristic is possessed in a spectacularly greater degree by the engineer than by the educator. Nor is education blessed with the great tradition of efficiency that belongs to engineering. The techniques of education have not been systematically organized. The raw materials of educational engineering are human attributes which do not act with the certainty which characterizes the natural materials of the engineer. Testing and measurement are extremely difficult when people are involved. The engineer must work with decimal points and if he does not do so the defects in his structure are apparent to all. The educator can do somatic damage to a child and no one may be the wiser. However, during the forty years of early educational engineering, individuals are found in substantial numbers who patiently have labored to produce sound products.

THE "engineering method" which is described in the treatise by Hoover and Fish parallels that used by educators. Translated into a vocabulary indigenous to education, the method may be analyzed in its various aspects.

First, the educational engineer accepts an idea to develop, a problem to solve, or a question to answer. The idea may spring from his philosophy of education, from an examination of programs and methods which do not work, from his administrative superior who assigns a project to him, or out of the air. The act of acceptance is not passive. He weighs it in rela-

tion to its possible productivity and his personal interest. Because he has only a limited amount of time and energy, he must accept and reject with care.

Having accepted an idea to work upon, his next step is a logical definition of the problem. For instance, his assignment may be to construct a spelling curriculum for the first eight grades of the elementary school. Does this mean an organized curriculum or a list of words to be taught? If the latter, shall the words be taught incidentally in relation to pupil use or in systematically arranged spelling lessons? Shall the final product include teaching aids? Numerous questions such as these must be answered before he knows exactly what his assignment means. He must know precisely what he is supposed to do.

When a problem has been defined, the educational engineer analyzes it to discover the factors that must be considered. Each of the factors requires analysis sufficient to bring it under control. Thereupon, the assignment is planned. His attention is engrossed in the methods to be used to control the factors. He concentrates upon the "how" of his project; he decides that he will define the objectives in this manner, make his selection of words in that fashion, and determine the related characteristics in another way. These specifications he formulates with the greatest care because upon their excellence rests the success of his projects.

Having completed his plans, he proceeds to construct his project by carrying out the operations which have been specified in the manner decided upon. The labor of construction consumes the major portion of the time spent upon a project although the plan is the most critical step in program building. When the instrument has been constructed, operation follows. Planning and construction have been carried on to that end. The idea has been given body on the assumption that, when properly implemented, it will improve instruction. The problem has been solved with the expectation that its solution will increase the efficiency of school processes.

The final phase of the engineering method in education is evaluation. When the operation is completed, it is tested to see if it fulfills its function adequately. If it does, it continues to be used. If it does not, it may be discarded. But if the idea is properly treated in the early stages of the engineering process,

[*Continued on page 56*]

Thinking in Grade III

By NORMA GRENER AND LOUIS RATHS

AN EXPERIMENT designed to test the hypothesis that the thinking ability of third-grade children can be measurably improved during one semester was tried in the Indianola Elementary School of Columbus, Ohio. Anecdotal records of what the children said and did were carefully kept by the teacher. The children were given two tests[1] in September and the same two in January to attempt to measure the growth in thinking and any changes in values which occurred between September and January.

The tests used were devised by the junior author under the supervision of the senior author. In the first test the children were provided with descriptive situations and certain necessary facts to carry out a problem. Below each described situation, there were a number of statements which were to be marked "true," or "false," or "we cannot tell," as determined by the paragraph read. The following item from the test is representative of it:

Pupils in a fourth grade were playing in the yard. George wanted to climb the pole. His teacher told him not to climb the pole, because he might fall and hurt himself. George replied, "I climb tall trees at home, and I have never hurt myself."

Mark the sentences with—

T —true from what is given here.
F —false from what is given here.
W—we cannot tell from what is given here.

..... 1. George liked to climb.
..... 2. The teacher told George not to climb all the way to the top of the pole.
..... 3. George did not like to play baseball.
..... 4. George climbed the pole.
..... 5. George had never fallen from a tree.
..... 6. The teacher wanted George to climb the pole.
..... 7. George could climb tall trees.
..... 8. When George grows up he will like to ride in airplanes.

The second test was one which combined the children's values with their ability to think. They were asked to mark one of several possible answers, standing for certain values, good, bad, and indifferent, in regard to problems within their experience. A portion of the second test follows:

[1] These tests may be secured by writing to Miss Grener.

Donald came rushing into the schoolroom just at 9 o'clock. His hair was uncombed, his face dirty, and he had had no breakfast. He would have been late had he taken care of these needs. What should Donald have done?

..... 1. He did the right thing. He should do anything to keep from being tardy.
..... 2. He should have been late and have taken care of all of these needs at home.
..... 3. He should have set the alarm clock the night before.
..... 4. He should have eaten his breakfast and then have hurried on to school even though his face was dirty.

The work of the classroom, whenever possible, was attacked as a problem. The teacher assumed the rôle of a guide who helped the children to find their own hypotheses and to furnish their own relationships. Thinking proved time-consuming, but the learning and experiencing which were associated with the thinking process were really worth the time spent.

CLASSROOM procedures which were intended to stimulate the thinking of this group of children included:

1. Books read were shared with others by selecting the most significant parts of the story to relate to the group.
2. Discussions of certain individuals, stressing the social implications of their behavior, were used as practical examples of reasoning.
3. Plans were made for the bulletin board, giving thought to the space available and the number of pictures to be used.
4. Creative writing afforded the problem of organizing material and presenting it well. This was a real problem to the third-graders since they were in the beginning stages of writing.
5. Questions were asked by the children and by the teacher, relating to the topic under discussion or to a book that was being read or shared.
6. Criteria for the selection of a unit of work offered many problems.
7. Many small items suggested for a unit were combined in larger and more comprehensive topics.
8. Books were made at the conclusion of a unit of study. This included the problems of arranging pages and making covers, and preparing the table of contents.
9. Discussion and criticism of the children's pictures, constructions, paintings, modelings, and writings gave opportunities for thinking.
10. Plans for the construction of various objects during the unit of study, and the estimation of length, distance, size, price, and so on, were suggestive.
11. Plans arranging the day's activities gave opportunities for judgment.
12. Lists of questions about the unit of study were devised.
13. Plans about sharing the culmination of a unit with another class were discussed.
14. Plans for trips and parties for Halloween and Christmas gave opportunities for practical judgments by the children.

15. Letters, including letters of thanks, of invitation, and of friendship, were written.
16. Poems were written.
17. Units involving problems of how to organize the material and make outlines were summarized.
18. Passages of music and phrases in poems and songs were interpreted.

The anecdotal records showed many examples of thinking. For instance, in connection with a movie shown about a camel caravan (which was used because Tommy's brother, a soldier in Africa, had had his picture taken with a camel and had sent it to Tommy with a description of his sight-seeing tour by camel), one of the questions asked was, How do they know where they are going, out on that big desert?

FRED: "They might use maps."
TEACHER: "How could they tell what direction they were going by looking at the map?"
JOAN: "Maybe they have landmarks."
PAUL: "I'll bet they use a compass."

This brought up another topic for discussion: what a compass is, and how to tell directions if you know which direction is north.

TEACHER: "Can you think of another way that desert travelers can tell directions besides using a compass?"
FRED: "By the stars at night. If you can find the big dipper in the sky, you can always find the North Star."
JAMES: "In the daytime you can tell directions by the sun because the sun comes up in the east and goes down in the west."

There were many opportunities for thinking in other subjects such as number work. Weight and height charts had to be filled in, both in September and again in January, at the end of the semester. Here were some fine chances to use numbers purposefully. The children used a yard rule to measure one another's height. It was found that Joan was 17 inches more than one yardstick high. That raised the question, "How much are 36 and 17?" Mary Jane said, "You must add to find out. Since 7 and 6 are 13 and 3 and 1 are 4, the answer would be 413." The children knew that couldn't be right. "That just isn't right," said Bill. "Something must be wrong." They finally figured that 36 and 17 are 53. Then it was seen that they needed to carry the ten of 13 when they added 7 and 6. Thus, a new experience in numbers was met by the children through the process of thought.

As stated before, tests were administered in September and again in January to evaluate the growth in thinking made by the pupils. The difference between the "befores" and "afters" was very significant. All but two children grew in thinking ability, some a great deal, others only a little. The scores on the test of thinking ability are given in Table I. The September average for the group was 32.6; the January average, 44.1. The average gain of 11.5 points turns out to be a significant difference when the *t* test[2] is applied. The gains were made by both girls and boys and 24 of the 26 students showed progress. Thus the scores made by these children in January were significantly higher when evaluated by this statistical device than

TABLE I

SEPTEMBER AND JANUARY RESULTS OF THE INTERPRETATION OF DATA TEST FOR BOYS AND FOR GIRLS

Girl	September	January	Gain	Boy	September	January	Gain
(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
1 ...	46	49	3	1 ...	19	23	4
2 ...	25	50	25	2 ...	34	48	14
3 ...	41	52	11	3 ...	31	48	17
4 ...	31	44	13	4 ...	36	43	7
5 ...	21	37	16	5 ...	27	34	7
6 ...	36	47	11	6 ...	26	40	14
7 ...	20	39	19	7 ...	37	45	8
8 ...	41	48	7	8 ...	22	50	28
9 ...	40	55	15	9 ...	25	45	20
10 ...	29	46	17	10 ...	29	42	13
11 ...	33	45	12	11 ...	44	39	−5
12 ...	34	46	12	12 ...	40	33	−7
13 ...	40	45	5	13 ...	40	53	13

those made when school began in September. These figures do not, of course, prove that the method of teaching was the important causal factor promoting this change. It is possible, but not probable, that in the ordinary process of living, a change as great as this would occur in a period of five months. Nevertheless, this documented improvement is consistent with this teacher's efforts to promote improvement in thinking, and there is genuine satisfaction to be derived from that consistency.

Not alone from test results but from personal observation, too, it was readily ascertained that the children's thinking ability grew. The anecdotal records based on statements made by the children in September were compared with statements

[2] The "*t*" is a test of the significance of a difference between the means of two small samples as devised by the English statistician, R. A. Fisher, and described in his book, *Statistical Methods for Research Workers* (London: Oliver and Boyd, 1938. pp. 126–27).

made by the same children in January. These, too, gave evidence of the thinking development of the children.

The teacher who worked with these pupils after they passed to the fourth grade remarked that this group surpassed many others she had taught, in their enthusiasm, inquisitiveness, and creativeness.

The junior author, as a result of this experiment in furthering the thinking ability in third-grade children, has set up some guiding principles which she thinks are helpful:

1. The teacher should be a guide who learns and investigates along with the children.
2. The curriculum should be one of problem situations, where the children are striving not merely to find answers, but to solve problems, find reasons for certain happenings, see further problems for more study, and develop more interests and curiosities.
3. The children should be free to discuss, express their opinions and ideas, act, plan, and share; but the teacher has a right to expect them to accomplish and execute. They should be taught to be responsible for what they set out to do and to finish what they begin. Children should know that this is a duty of theirs in a democracy.
4. The richest thinking comes through group work. Criticism, evaluation, and planning, in co-operative endeavor for a common purpose, stimulate thoughtfulness.
5. The thinking process takes time and patience.
6. Individuals cannot think in a vacuum. To form hypotheses, children must have information and functional skills. By no means should the acquisition of functional skills be neglected when thinking is desired.
7. There must be purpose in the activities and experiences that the children undertake. It must be child purpose, guided by the teacher. There must be no abstract learning, but an integrated core of experiences, as that is the only way purpose comes.
8. Self-direction, self-discipline, and good habits and attitudes need to be continually developed in children who work in a thinking environment. People cannot be forced to think, so they must develop enough inner drive to feel it their responsibility to do so. They must be constantly forming habits and attitudes which make for a good atmosphere in the schoolroom and for good citizenship in adult life.
9. Rich and varied experience is a necessary foundation for reflective thinking. By meeting new experiences, children's curiosities are aroused. If the experiences are varied enough, all of the children's interests can be reached.

A continuing emphasis throughout all the school years on improvement in the thinking process might be the greatest contribution we could make to the improvement of instruction in the elementary school.

Role of Visual Materials

By EDGAR DALE

THOSE interested in the increased and more intelligent use of audio-visual materials in the schools will save time and effort if they understand better the general educational principles under which they are operating. The statement of some of these principles will invite intelligent criticism and raise doubts as to some unjustified claims.

First, the term *audio-visual materials*, if interpreted literally, is a misnomer. There is a visual sense, it is true, and the senses do play a very significant rôle in education, but we as teachers do not work with single senses. We work with experiences which are multi-sensory. It is the totality of experience and not its individual sense components which is important to the teacher. Wheeler and Perkins say on this point:

> The ear, alone, does not determine what the nature of an auditory experience will be. A field of experience and a total nervous system are necessary.
>
> . . . . . .
>
> . . . in mental life, there are no discrete sense departments. There are specialized organs of sense, the retina, the cochlea (inner ear), and—organs in the skin and muscles; but they are specific anatomically, not functionally.
>
> . . . . . .
>
> The results just discussed show that the sense organs always function in a mutually dependent fashion. Each perception of a single stimulus involves a response of the total organism.
>
> . . . . Because objects are presented to one of the so-called senses, say hearing, is no guarantee that the child's awareness of the object will involve only auditory processes. The meaning of the object will not be apprehended until it is perceived in the light of a total situation *with the aid of other senses*.[1]

Second, a much larger proportion of school experiences than we may be willing to admit is barren and verbalistic. This is true for two reasons. First, many of the experiences which we introduce within the school have little relationship to pupils' lives. This is either because the experiences are introduced too early or too late, or because they have very little tie-in with what boys and girls are thinking, doing, and feeling.

[1] Wheeler, R. H., and Perkins, F. T. *Principles of Mental Development.* New York: Thomas Y. Crowell Company, 1932. pp. 140, 141, 146, 147.

A second reason for undue verbalism is that the verbal skill of teachers enables them to generalize more quickly and to see relationships more skillfully than the average person. As a consequence, teachers are willing to accept a student's verbalistic recitations and explanations which really may not be understood by his classmates. We know that pupils can name a group of explorers but may not know what an explorer is. They may speak and write with facility the definition of oxidation, yet fail to note ordinary examples of oxidation which lie all about them. They may even memorize complicated formulae in the field of physics and yet may not be very certain whether they fall forward or backward when the streetcar suddenly stops.

Two evils result from this mechanistic and sterile treatment of factual information. The first is overemphasis of the typical recitation lesson in our high schools. The second is a large amount of forgetting.

The studies of Ralph W. Tyler and others have shown high amounts of forgetting of factual materials after a period of time has elapsed. This forgetting is much greater with vocabulary items and discrete data than it is with principles and generalizations. While a certain amount of forgetting is normal and desirable, nevertheless the forgetting of materials taught to be remembered represents an educational waste.

Third, teachers of the past were skilled in handling words. The teachers of the future must be skilled in handling experiences. This is a glittering generality. What does it mean? Teachers in the past have been trained to use textbooks and reading materials. These textbooks and reading materials, generally speaking, are easily adapted to reading and reciting methods. They are divided into chapters, divisions, and the like. One can get a grip on them. They can be assigned, tested upon. But an experience, such as a field trip or a motion picture or a demonstration, is not so easily handled. It has dozens of aspects or leads.

Teachers, therefore, must see much more clearly than before what it is they are driving at. They must have a better concept of the principles they are trying to develop, and they must understand the rôle of active experience in developing these generalizations.

It would be relatively easy, for example, for a teacher of the fourth grade to have children memorize the terms *herbivorous*, *carnivorous*, and *omnivorous*. A perfect examination

could be passed upon facts connected with these terms. Yet, unless children were actually given an opportunity either directly or indirectly to have rich experiences with animals, to know their feeding habits, and the like, such information at the outset would not be functional and, second, would be quickly forgotten.

Fourth, experiences are found at varying levels of generality and abstraction. A child, for example, may have experience with Rover and yet have no general concept of a dog. After a while, when he sees many kinds of dogs, he realizes that Rover belongs to a class. We would think an eight-year-old child dull if he could not tell the difference between a dog and a horse, even from crude drawings, but he knows this distinction perfectly well because he has had rich and varied experiences with these animals.

He is still likely, however, to call a whale a fish. Indeed, the German name for whale is *Walfisch*. But if he is a biologist, or thinks scientifically, he will call a whale a mammal, and if he has had enough experience with what has been called mammalian, he never forgets it.

The fact that experiences exist on different levels of abstractness is a very important concept in the whole field of audio-visual education. We need to see that experiences can exist in the full-bodied sense, that we meet them directly, as when we take a field trip, or that we meet them much more indirectly, that is, symbolically. Teachers must understand that thinking is a process of rehearsing in symbolic fashion the actions that would otherwise have to be performed overtly. Einstein thought out symbolically (using paper and pencil and mathematical symbols) a theory of relativity. This theory was then checked concretely by observation of astronomical phenomena.

Language, whether it is heard or read, serves this symbolic purpose. Words, of course, may not have a concrete reference. They may express a relationship. This relational aspect of language is often forgotten by persons interested in visual education. You cannot draw a picture of *and, but, for, however.* Indeed, such words as *niece, husband, father, mother* have a spurious concreteness and younger children have difficulty in understanding them. The term *daddy* often means *man* to a little child. Teachers need to understand this progressive level of symbolism in experience; otherwise, they will permit the child to offer a verbal substitute for an experience that he

actually does not possess. Hence, in arithmetic, children discuss *bonds, stocks, savings accounts,* and the like, when many of them lack any direct experience with these concepts.

Fifth, just as it is possible to move too quickly to generalization and abstraction, so too is it possible to stay too long at concrete levels. John Dewey has pointed out that:

> While direct impression has the advantage of being first hand, it also has the disadvantage of being limited in range. Direct acquaintance with the natural surroundings of the home environment, as a means of making real ideas about portions of the earth beyond the reach of the senses and as a means of arousing intellectual curiosity, is one thing. As an end-all and be-all of geographical knowledge it is fatally restricted. . . . Just as the race developed especial symbols as tools of calculation and mathematical reasonings, because the use of the fingers as numerical symbols got in the way, so the individual must progress from concrete to abstract symbols—that is, symbols whose meaning is realized only through conceptual thinking.[2]

Sixth, the school of the future will be characterized by greater opportunities for richer learning experiences. Instead of placing dependence only upon reading and then, unfortunately, primarily on textbook reading, we shall make increasing use of field trips, dramatization, demonstration, models, specimens, museums, sound and silent movies, stereoscopic still and motion pictures, flat photographs, glass and film slides (especially the 2 by 2 slide), charts, maps, globes, and recordings.

Our present dearth of learning materials makes it impossible to make adequate provision for those children who do not learn easily through reading methods. This will be remedied. Further, by providing a greater variety of experiences we shall get a re-enforcement of learning that is not now secured. In a good deal of our teaching not quite enough experience is provided the average child to get him "over the hump" as far as learning is concerned. By offering a richer bill of fare we may be able to develop learners out of children who do not thrive on current educational materials.

The term *audio-visual materials* may not be adequate to symbolize this richer body of experiential materials. If the term finally does prove inadequate, certainly it will have ably served during the interim period to remind all of us that the school and the community can now offer much richer, more adequate learning materials, and that there is no time like the present to begin providing them.

[2] *Democracy and Education.* New York: Macmillan Company, 1924. p. 315.

EDITORIAL COMMENT

The Schools and the Veterans

THERE is today a good deal of discussion and planning with respect to the education and training of veterans under the "G.I. Bill of Rights." This is as it should be; this education and training will be a large task and present many complex problems. But relatively too much of this discussion and planning has had to do with veterans' education in colleges and other higher institutions and not nearly enough with other types of education.

The law provides that veterans may receive education and training at government expense, not only in colleges, universities, and professional schools, but also in "public or private elementary, secondary, and other schools furnishing education for adults," junior colleges, and apprentice and other programs of training on the job conducted by business establishments.

The largest part of the job of educating veterans will be on the subcollege level. Figures compiled by Selective Service show that as of June 30, 1944, 25.9 per cent of all Army enlisted men had received an eighth-grade schooling or less, and an additional 32.9 per cent had had less than four years of high-school work. Of male Army officers, 1.5 per cent had not more than eighth-grade schooling, and an additional 12 per cent had not finished high school. In other words, about 60 per cent of enlisted men and one officer out of seven will not be eligible for admission to college, except as some of them may be deemed eligible because of maturity and military experience or educational work carried on while in the service. Many of those eligible for college admission will desire, and will be better served by, educational programs other than those which have ordinarily been given by colleges. Many will want short courses of from six months to two years duration, focused rather directly on specific vocations. Under the law, those not desiring or not eligible for college are entitled to just as much education or training as those who have Doctors' degrees.

A study of a sample of 20,000 army men from all theaters of war shows that 31 per cent definitely or tentatively plan to continue their education. While economic conditions after the war will largely determine the number who actually do so, the number will unquestionably be large.

MAR 31 945

These facts add up to a major challenge to public schools. With so much public money available, there is grave danger that proprietary fly-by-night schools will be set up, which will be more interested in getting the government money than providing adequate education for veterans. Constituting a safeguard against such a development is the provision that no government money can be paid for the education of a veteran except in an institution approved by the appropriate state authority (in most cases the State Department of Education). State departments should recognize their obligation to approve only programs, whether provided by public, parochial, or proprietary enterprises, which meet reasonable standards of quality. And school people should give their moral support to the departments which will have to resist strong political pressure.

But this is not enough. If public schools are really to meet their obligations in this matter, they must, in many cases, themselves provide programs to meet the needs of veterans, and thus cut the ground from under inefficient and selfish educational enterprises. This will call for evening and other part-time classes, co-operation with industry by giving related instruction in apprentice programs, separate classes for veterans to avoid mixing them with regular high-school students who are their juniors in age and experience, and many other departures from conventional practice.

Only as schools are willing to break with tradition and center their attention on veterans' needs rather than on conventional school procedures, will they meet the great challenge.

R. H. E.

By the end of 1945 there will be approximately three million young persons between the ages of fourteen and twenty-two who left school for employment during the war years before completing high school. Data available suggest that these young people are of a low level of education, a low level of ability, and not especially interested in continuing their schooling. When the market for their services has collapsed after the war is over, their needs will be not unlike those of many young veterans. It will be economically important, as well as socially desirable, to remove as many of them as possible from competition with adults in the labor market by providing some type of educational program for them.

READINGS

Books to Read

WARNER, W. LLOYD; HAVIGHURST, ROBERT J.; LOEB, MARTIN B. *Who Shall Be Educated: the Challenge of Unequal Opportunities.* New York: Harper and Brothers, 1944. xii+190 pp.

This is a very thoughtful book. It will not appeal to readers who are seeking "escape literature." It will be uncomfortable reading for those who like to evade the pain of individual human problems by grouping them in classes or losing their identity in statistical tables. It is stark realism, but it is no more discouraging or sordid than reality. It smells like children's unwashed hands, and third-grade examination papers, and school cloakrooms, and clothes hung in the kitchen on washday while the vegetable soup is cooking for supper.

But behind all this are flashes of the heroic endeavor of hopelessly burdened children and teachers and administrators to transcend their limitations—personal, familial, and social—and achieve the ideals of mobility, gentility, and opportunity, for which democracy stands. The stories of individuals of various social and racial groups have been furnished to the author-editors from the actual part of the country for which they are presented as typical. They are not fiction.

Not only the pupils but the teachers use education as a means of "getting ahead in the world." Middle-class standards of refinement and ambition mean a great deal to them. But the middle-class viewpoint is going to change a great deal in the next few decades, and the rôle of the teacher as an example of the philosophy of unlimited progress through industry and ambition is going to change to one which has a more realistic view of society and human nature. The rôle of the teacher is bound to become more subtle and more creative as this change progresses.

Who shall be educated? The present choice of who shall be educated must be changed if America is to maintain its democratic way of life. Social engineering will devise ways for taking account of social change, and for educating youth for this. We shall need to understand social mobility more thoroughly, and perpetuate it more purposefully and deliberately than is now the case. High schools will need to have three program goals: general education, vocational training, and avocational activities.

EMILY L. STOGDILL

UMSTATTD, J. G. *Secondary School Teaching.* Boston: Ginn and Company, 1944. xii+488 pp.

This volume is a revision of an earlier work by the same title. It is primarily addressed to prospective teachers and is designed for use as a textbook in teacher-education classes. The author's claim, however, that it should be of value to the teacher in service is perhaps justified.

The point of view of the book is rather conservative. It stresses heavily the unitary treatment of experience but takes little account of the trend toward the breaking down of subject-matter lines. The author does, however, deal effectively with the use of audio-visual aids which he sees as an integral aspect

of the curriculum. There is a comprehensive treatment of the workbook idea, which the author believes to be generally sound.

The book closes with a chapter on teacher self-appraisal and rating scales. The use of rating devices is looked upon with suspicion because of their unreliability. The author, however, submits a scale of his own which he thinks should be helpful to the prospective teacher for self-evaluation. Of the several rating scales presented, he states: "They should prove of value to students who may wish to rate themselves or to have their friends rate them" (page 467). What the possible effect of the rating upon friendship might be, is not discussed.

HAROLD ALBERTY

FENNER, MILDRED SANDISON, AND FISHBURN, ELEANOR C. *Pioneer American Educators.* Washington, D.C.: National Education Association, 1944. 160 pp.

This is a pocket-size volume containing brief biographical sketches of Thomas Jefferson, Horace Mann, Henry Barnard, Emma Willard, Mary Lyon, Thomas Gallaudet, Bronson Alcott, Mark Hopkins, Elizabeth Peabody, Susan B. Anthony, Frances E. Willard, Clara Barton, Alice Freeman Palmer, William T. Harris, Booker T. Washington, Ella Flagg Young, Charles W. Eliot, and Martha Berry. These are written in an interesting journalistic style, and evidently intended for the general reader. There is also a brief biographical dictionary of famous names in American education.

R. H. ECKELBERRY

ALEXANDER, CARTER. *Tomorrow's Libraries for Teachers Colleges: a Check List to Aid in Securing Library Plant and Equipment Equal to the Expected Demands on These Institutions.* No address: Committee on standards and surveys, American Association of Teachers Colleges. No date. 60 pp.

The subtitle of this publication is far more truly indicative of its actual content than is the main title. For this is not, as one might expect, a theoretical discussion of the place of tomorrow's library in a teachers' college. It is a detailed check list, with ample discussion of points raised, to be used by faculty committees in determining the future needs of their libraries and in developing plans to provide for these needs.

Starting with the organization of the Planning Committee, it carries through to a discussion of the site and architecture for such a library. Throughout the list, existing library building standards are considered and used, together with such additional considerations as the author, in his experience, has found to be desirable. Though the check list is not designed primarily for the use of librarians of teachers' colleges, they will find it most helpful in steering their planning committees toward plans for an adequate and desirable provision of buildings and equipment to meet the future needs of their individual institutions.

It is to be hoped that this publication will find wide usage immediately, while institutions are planning their postwar building programs. Its wise use now may prevent many an unwise decision and add much to the efficient plans for such buildings.

RUTH E. SEEGER

BOWEN, GENEVIEVE. *Living and Learning in a Rural School.* New York: Macmillan Company, 1944. x+324 pp.

Never have I read a book more deserving of its title. *Living and Learning in a Rural School* is an example of how a rural schoolteacher found ways for the children to work, play, and learn together and how all of their learning can be made purposeful.

Miss Lee, the teacher, seems to have unusual success in sensing the abilities and limitations of different children. Her approach in teaching is based on the premise that children have all sorts of interests, needs, and possibilities, but that each child is an individual and may need to be handled and treated differently. A great deal of emphasis is also laid upon the importance of home-school co-operation and the home of each child is visited in an effort to secure this co-operation. This work indicates that much-improved understandings and relationships would exist if all teachers were to follow this practice.

The author also emphasizes the need and importance of an individual cumulative record. This is not to serve particularly as an official record, but rather as a guidance tool. The importance of taking stock of one's progress is also emphasized and the plan used and points considered are very interesting.

This little book should prove interesting and challenging to all rural teachers in particular and to all individuals working with people.

E. O. BOLENDER

DETROIT PUBLIC SCHOOL STAFF. *Frank Cody: a Realist in Education.* New York: Macmillan Company, 1943. x+572 pp.

The recently published book, *Frank Cody: A Realist in Education*, is a rather unusual publication. It is a biography of Frank Cody, one of the most unusual characters in the history of public-school administration, and was written by his associates in the conduct of the Detroit public schools. It is, therefore, both a biography and a history of the administration of the schools under Cody's leadership.

Frank Cody's youth was quite typical of that of many young men who entered the teaching profession fifty years ago. There was nothing unusual or startling about his education or his early experiences. He advanced into the Detroit school system by annexation when the district in which he was employed became a part of Detroit.

Early in his career, he demonstrated the powers of commanding personal popularity which, along with personal integrity, in 1919 gained for him the office of superintendent of schools in America's fourth city. His success as superintendent was instantaneous and continued throughout the quarter-of-a-century tenure in this office.

The authors demonstrate quite fairly the two basic attributes on which this success depended. One of them was the unusual ability to delegate responsibility to those whom he selected for important posts in the Detroit schools and then keep his hands off, while supporting them in their efforts. The other was the unusual ability to see the humorous side of any acute situation.

Through the exercise of the first of these attributes, he developed a strong, growing staff of capable men and women who made their contributions to the advancement of the schools, both as individuals and as a group. Many seemingly critical situations which arise in the administration of a large school

system are too often magnified by the school administrator. Not so with Mr. Cody. The gathering strain which seemed to be at the bursting point would be quickly and effectively deflated by his unparalleled ability to parry with a humorous anecdote or witticism. Mr. Cody knew that most so-called rough spots smooth out if left alone, but he aided and abetted their going by refusing to consider them seriously. At least that was the external Mr. Cody. What he really felt and experienced inside will probably not be revealed unless Mr. Cody writes his autobiography.

This review is an oversimplification of the book which is replete with experiences connected with Detroit's educational problems and how they were solved. From this standpoint, too, the book is a valuable addition to the literature on school administration.

H. W. ANDERSON
Newton, Massachusetts

GREENHOOD, DAVID. *Down to Earth.* New York: Holiday House, 1944. 262 pp.

Down to Earth is certainly one of the best of the numerous recent publications in the field of cartography. In many respects it is unique. Its content is presented in pleasing vivid style.

Mr. Greenhood's story covers not only an explanation of various map projections, but includes simple instructions for their construction, consideration of the problems and purposes of mapping, various devices to make maps effective and attractive, equipment needed to draw maps, useful tables, an excellent annotated bibliography, and an adequate index. The illustrations are to be commended not only for their attractiveness but for their many unusual designs and their contribution to the clarity of presentations.

The reviewer would take issue only with the statement on page 32 to the effect that "geography is not old stuff." It is very old but happily widely applicable to current affairs. On the other hand, the reviewer cannot refrain from congratulating the author upon his praise (page 113) of the Mercator map which in recent years has too often been maligned.

This book is an important contribution to a better understanding of maps, their construction and use.

EUGENE VAN CLEEF

CHITTENDEN, GERTRUDE E. *Living with Children.* New York: Macmillan Company, 1944. vi+163 pp.

In her foreword, the author expresses the hope that college students

> . . . just being introduced to the field of child development . . . may be persuaded to see themselves not only as parents or prospective parents . . . but as community members responsible for the welfare of all the children.

This reviewer is acquainted with no other title which so skillfully emphasizes research through citing original sources and at the same time shows that what happens to one individual inevitably affects all. There is refreshing integration of the most sane, up-to-date points of view of psychiatry and education. Application of general principles is made meaningful by well-chosen illustrations which direct attention below the surface to fundamental causes and to prophylactic measures.

Applying the principle, "start where the child is," "growth in adolescence" is discussed first, then "growth in childhood." If more centers were using the practical criteria suggested in the five chapters devoted to meeting the child's needs in home, school, and community, there would be less uncertainty about the direction in which America is moving. Inevitably, in such a small volume much pertinent material has been omitted, but the author shows objectivity, skill, and understanding in her selection. Each chapter ends with a short bibliography and an exceedingly well-selected list of "problems for discussion and assignment." A final chapter consists of an annotated bibliography of simply written "usually available" material "about children and their families." The book could be used to advantage with high-school seniors.

FLORA LEE SHERMAN

MAGOUN, F. ALEXANDER. *Balanced Personality: How to Solve the Conflict between Desire and Conscience.* New York: Harper and Brothers, 1943. xi+304 pp.

The author visualizes personality as a teeterboard with Desire and Conscience at opposite ends and Wisdom acting as a balancing force in the center! Mr. Magoun, who is associate professor of human relations at the Massachusetts Institute of Technology, remarks:

There are two kinds of simplicity in the world: the simplicity of ignorance and at the other extreme the simplicity resulting from a knowledge which can discard everything except the essential. Doubtless I shall be credited with both kinds, though not by the same people (page ix).

A hasty glance through the book reveals the use of two attention-getting devices: many quite dramatic drawings based on the teeterboard motif, and many "patches of ready-made outlines, sprinkled through the text in the more complicated places," for "those who lack the fortitude for so troublesome a discipline" [as outline making] (page x). Three appendices, one on the "Habits of an Educated Man," the second, "Good Method for Analytical Study in Human Relations," and the third, a series of four work sheets, help the reader to make application of some of the principles in the book.

Those who have any background in psychology will find this an oversimplified, though clever, account of the balanced personality and the methods by which it may be achieved. Its viewpoint is neither unsound nor misleading except in the same manner as is true of other such oversimplified popularizations which appear from time to time in psychology intended for the general, uncritical, or immature reader. Some persons will question the advisability, as well as the pedagogical desirability, of the frequent use of the personified Desire, Conscience, and Wisdom.

EMILY L. STOGDILL

A Basic Book Collection for Elementary Grades. Chicago: American Library Association, 1943. 133 pp.

This is a classified list of desirable books for the curricular and recreational reading of elementary-school children prepared by a joint committee of the American Library Association, the National Education Association, and the National Council of Teachers of English. In organization and classification it follows rather closely the plan of the *Children's Catalog.* Approximate grade-levels, as determined by reading difficulty and maturity of interest, are

given for each title. The annotations, though brief, are informative. An excellent author, title, and subject index is included, as is also a directory of publishers.

The selection of books for inclusion seems to be well done, making of this list an excellent tool for librarians, teachers, and parents. Its use should take much of the usual "guess work" out of the task of selecting books for children.

RUTH E. SEEGER

JENNINGS, HELEN HALL. *Leadership and Isolation: A Study of Personality in Inter-Personal Relations.* New York: Longmans, Green and Company, 1943. xv+240 pp.

This is an extensive study of the process of choosing one's associates for various forms of social living. The techniques and concepts are those of "sociometry"—an interesting movement which undoubtedly is producing valuable insights, but a movement which tends to a certain amount of cult-like rigidity. Moreover, the book is far from easy to read; it is full of rather technically used terms, and its sentence structure is elaborate. I turned the pages at random and found on page 6 this sentence: "The social milieu is structured by the co-ordinations of functional interaction in the continuum of self with others." That sentence makes an important statement, but it is not, I think, easy for anybody to read. To say it more simply might require more words; but it would take less of the reader's time—and patience.

That having been said, it is time to recognize the genuine importance of this little monograph. It outlines and discusses procedures of admirable simplicity which yield valuable data for both theory and practice. And the analysis of how and why we make choice of companions in work and play; of our actual contacts with people and of the contacts we desire—all of this is immensely valuable. The kind of study of the interactions of individuals here carried forward will presently revolutionize—the reviewer means that seriously—the concept of the educational process. An eloquent and simple restatement of Miss Jenning's findings would be a first-rate contribution hardly second to her own pioneering research.

H. B. ENGLISH

ADAMS, JAMES TRUSLOW. *The American.* New York: Charles Scribner's Sons, 1943. ix+404 pp.

A widespread belief in racial characteristics of personality and intellect still persists in spite of the lack of any shred of evidence to support it. The belief probably arises from a false explanation of an observable fact, that nationalities or homogeneous groups of people do differ markedly in their values and patterns in spite of their common humanity.

These group or national characteristics are now generally conceded to result from social rather than biological inheritance. While some of the likenesses of a group may be easily recognizable in spite of the infinite diversity of the individuals who make it up, they can only be described and explained by sweeping generalizations, all too frequently based upon inadequate information. Too often, the intellectually cautious and the well-informed, aware of the pitfalls, leave the field to the ignorant, the malicious, or the chauvinistic.

Very fortunately for us, into this field comes James Truslow Adams with *The American*. As he says in the prologue, "This book is not about what people—Americans or otherwise—have done *in* or *to* America. It is about what America has done *to them*" (page 3). In this brilliant book, he has traced the groups which came, what they brought with them, and what factors in the environment molded them. Out of it emerges the first credible description which this reviewer has seen of the contradictory and endlessly variable but always recognizable American, and of the influences which produced him.

From the nature of the subject, Mr. Adams has had to make very broad generalizations. Behind them lies his wealth of historical information, so that even when one occasionally differs, one grants his right to a respectful hearing. Few are likely to quarrel with more than details, and all will bring from the reading a deepened understanding of ourselves and our era. It is a book to make a real contribution to our times.

MARGARET WILLIS

THORNDIKE, EDWARD LEE. *Man and His Works.* Cambridge, Massachusetts: Harvard University Press, 1943. 212 pp.

This is not a book for the layman, and yet the intelligent layman will find much to interest him. He will be surprised but not disappointed to discover that he did not guess right as to what the title means. He will find no bromidic discussion either of man or the works of man; instead, a rather startling demonstration of what the modern science of statistics with its partial correlations can do toward the solution of some of the most important problems of human relations, when used by one who has the skill, the vision, and the imaging power.

Each of the ten chapters glows with suggestiveness for those who are interested in human welfare. Space forbids extensive quotation. We content ourselves with one from the chapter on "The Psychology of Punishment":

> Psychology recommends that much more care be taken to attach the confirming reaction to desirable tendencies. Strengthening the habits whereby a person earns an honest living seems likely to be a more fruitful enterprise for government than punishing theft, forgery, and the like. Strengthening the habits of healthful recreation, fair play, mutual aid and kindliness seems likely to be more fruitful than punishing crimes of violence. Playgrounds seem more promising investments than prisons (page 162).

These "recommendations" are based upon psychological researches by the author and his colleagues, briefly described in this book.

HENRY H. GODDARD

BAKST, AARON. *Arithmetic for Adults.* New York: F. S. Crofts and Company, 1944. vii+320 pp.

The author of this book says it was written to enable adults to master the rudiments of arithmetic in the technique of the subject with typical applications. Treatment of the subject-matter is done in the traditional mathematical manner but without a single proof in the book.

The first chapter, entitled "The Decimal System of Numeration," is historical and somewhat interesting, but the reader would be left "up in the air" unless further orientations were made. In all, there are eighteen chapters, other typical ones being entitled "Decimal Fractions, Common Fractions,

Operations with Fractions, Ratio and Proportion, Percents, Logarithms, The Slide Rule." The Appendix of only ten pages includes tables of various units, formulas from geometry, and very simple trigonometry with a small table.

Some of the explanations of rather simple ideas are "over explained," while the applications covering a wide variety of topics are meager and not well ordered. An explanation of the use of the equation involving the equality sign should have been given. On page 106, no explanation is given as to why 1000 divided by 2·3 equals 1500 (which is not true as it stands). The multiplication table (page 47) should certainly have been replaced by a table of products whose factors are to be supplied. Here the student, using such a table, gives the factors of the products 4, 6, 8, 9, 10, 12, 14, 15, etc. up to 144, these being the products from the usual tables through the twelves. The tables, formulas, and the like in the Appendix are very meager for a book that treats logarithms, etc. Moreover, everyday necessities in common arithmetic, especially for adults and for a book that is called "a wartime book" certainly would demand an arithmetic treatment of the milk industry and the simple fundamentals of graphic representation.

The book is well printed and "groomed" and on good paper.

S. E. RASOR

Is There a Field of Educational Engineering?

[*Continued from page 37*]

evaluation and testing result in further improvements in the program rather than in rejection of it.

Schools and colleges have established noteworthy units to study structures and programs in the form of bureaus of educational research, known by a variety of names. Increasingly, they are using the regular services of consultants who supervise the planning and operation of new programs and thereby gain access to the techniques of the educational engineer.

In the judgment of the writer, it is appropriate to add *educational engineering* to the technical vocabulary of education. The engineers will be glad to lend it, as an older brother to a younger, and the educational field needs the term as a reminder that the profession needs more engineers to supplement its idea men.